Supplement of "**Size-resolved mixing state of black carbon in the Canadian high Arctic and implications for simulated direct radiative effect**"

Bounding cases of coating thickness for rBC cores less than 140 nm and resulting direct radiative effect

To determine the coating thickness as a function of rBC core diameter (as shown in Figure 2) the rBC cores were binned in 5 nm intervals and the median coating thickness across all flights and measurements was calculated for each bin. However, since there is a known bias toward thicker coatings at smaller rBC cores sizes, this median value is not accurate for rBC core diameters less than 140 nm. This is due in large part to the fact that small particles with thin or no coatings do not produce a detectable elastic scattering signal and therefore cannot have a coating thickness determined for them. To overcome this, conservative minimum and maximum coating thickness were also calculated for each bin. We estimated minimum coating thicknesses by assuming that all particles for which a coating thickness could not be determined were bare rBC particles. We estimated maximum coating thicknesses by assuming that all particles for which a coating thickness could not be determined had the median coating thickness from the successful fits. For bins where >90% of all particles could be successfully assigned a coating thickness, the minimum, maximum, and median were very similar. For smaller particles, where <90% could be assigned a coating thickness, the differences were significant. In order to overcome the known biases in the median for these cases, we used the minimum and maximum coating values as bounding values. The median coating value for bins with <90% successful fits was set as the overall median coating thickness from bins where the LEO success rate was 90% or greater. For rBC core diameters larger than 220 nm, the median value for a 220 nm particle was used. The results from this are shown in Figure S1. This process was carried out separately for each flight and the average of all flights (black line in Figure S1) was used for the GEOS-Chem simulations.

Table S1 presents the resulting direct radiative effect (DRE) for the r_{shell}-*constrained* and *fBC-constrained* mixing states considering the minimum, median, and maximum coating assumptions. Overall there is not a large difference in DRE across the minimum and maximum assumptions. This is due to most of the optical extinction taking place at particle diameters greater than 140 nm.

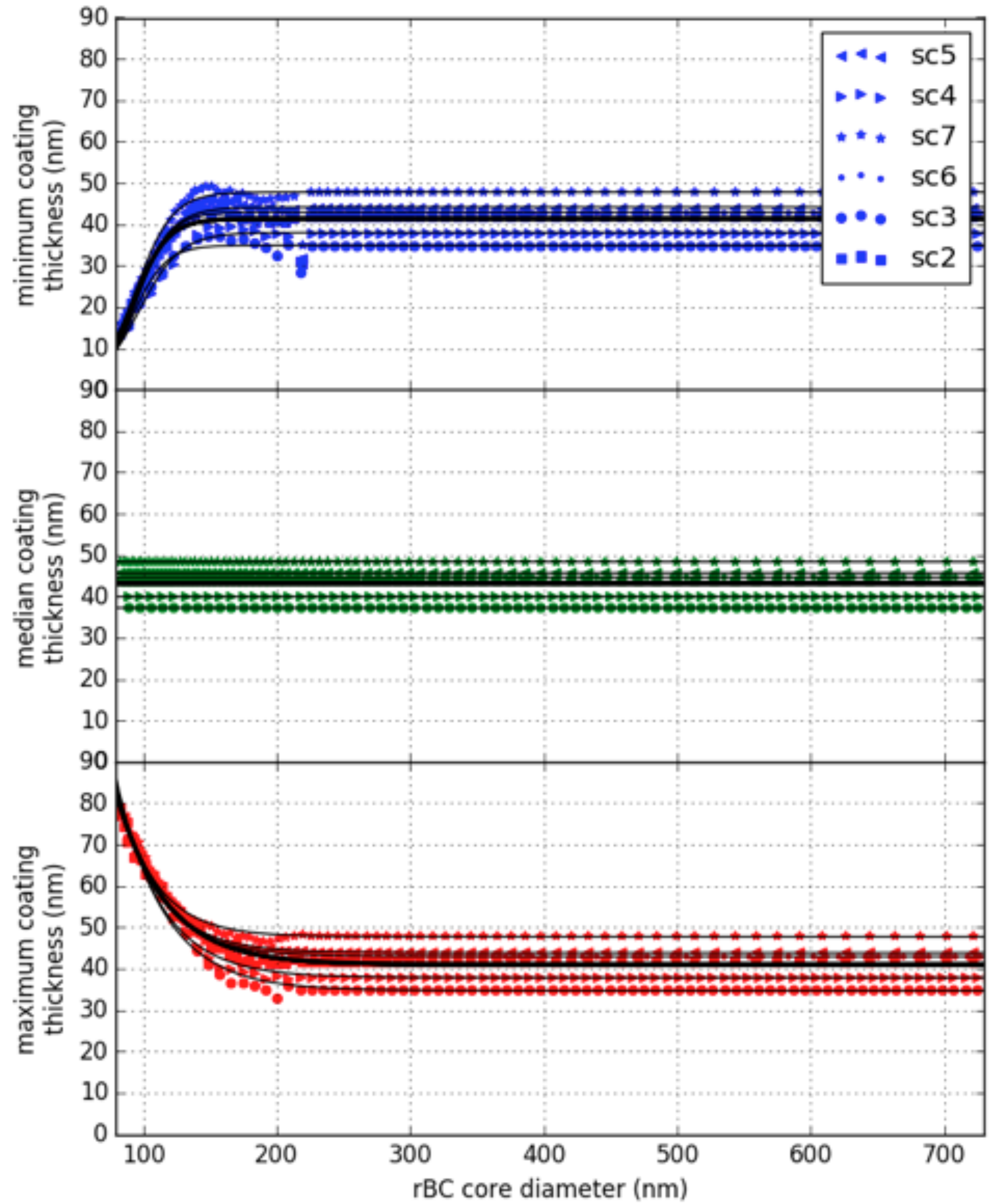

Figure S1. Minimum, median, and maximum possible coating thicknesses as a function of rBC core diameter. In each scenario, there are separate symbols and a fit line for each flight, and there is a heavy black line which is the fit to all flights combined.

Table S1. The DRE for measurement-constrained mixing states using the minimum, median, and maximum assumptions.

Simulation		DRE [W m^{-2}]
fBC-constrained	min	-1.462
	med	-1.454
	max	-1.455
r_{shell}-constrained	min	-1.593
	med	-1.591
	max	-1.588

April mean albedo

Figure S2 shows April climatological mean albedo in the Arctic. Albedo climatology is derived from MODIS retrievals from years 2002-2007 and described in Heald et al. (2014). Ocean albedo is held constant at a value of 0.07; however, sea ice alters the spatial distribution of albedo. Estimates of DRE are likely sensitive to albedo climatology.

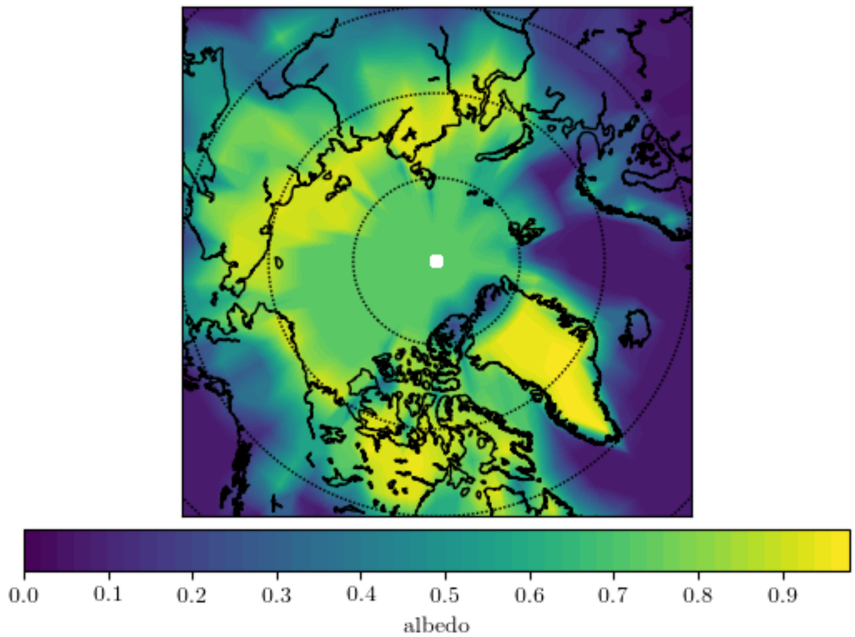

Figure S2. April mean albedo for visible wavelengths